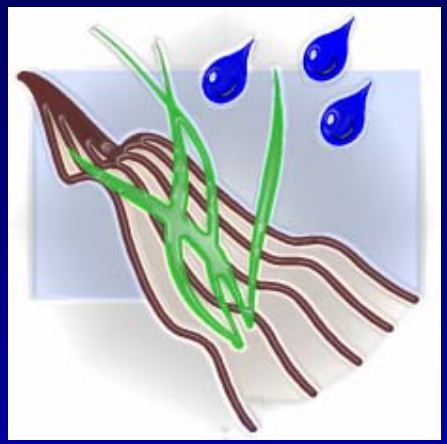


Past, Present & Future of Bioretention A Delaware Perspective

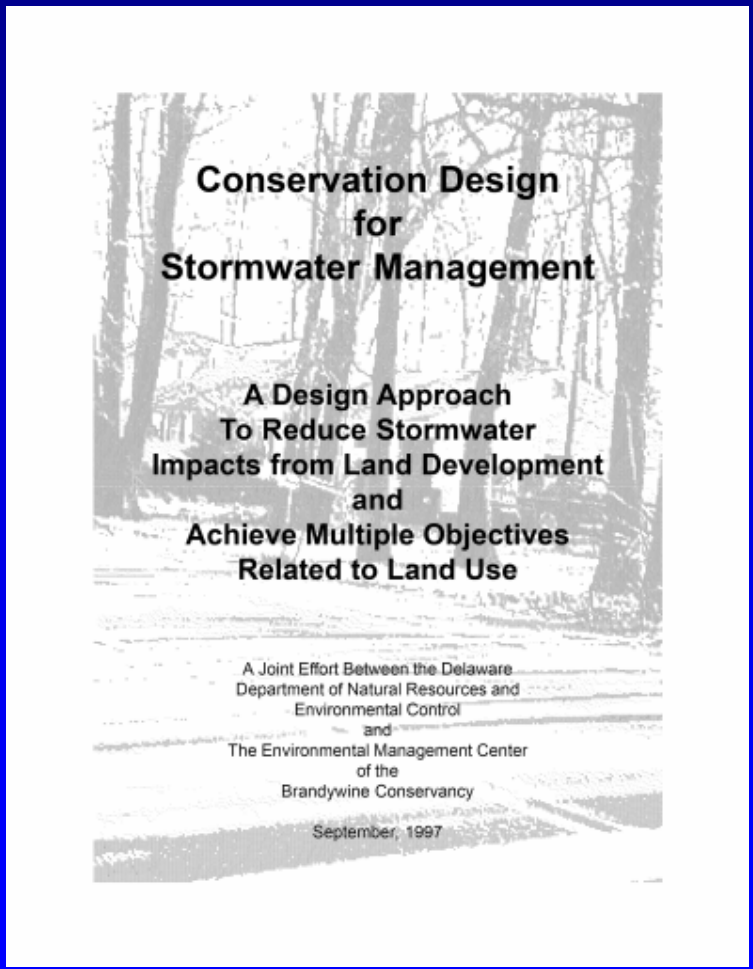
Presented at:

"Putting the LID on Stormwater Management"

The Inn & Conference Center – Marriott
College Park, MD
September 21-23, 2004

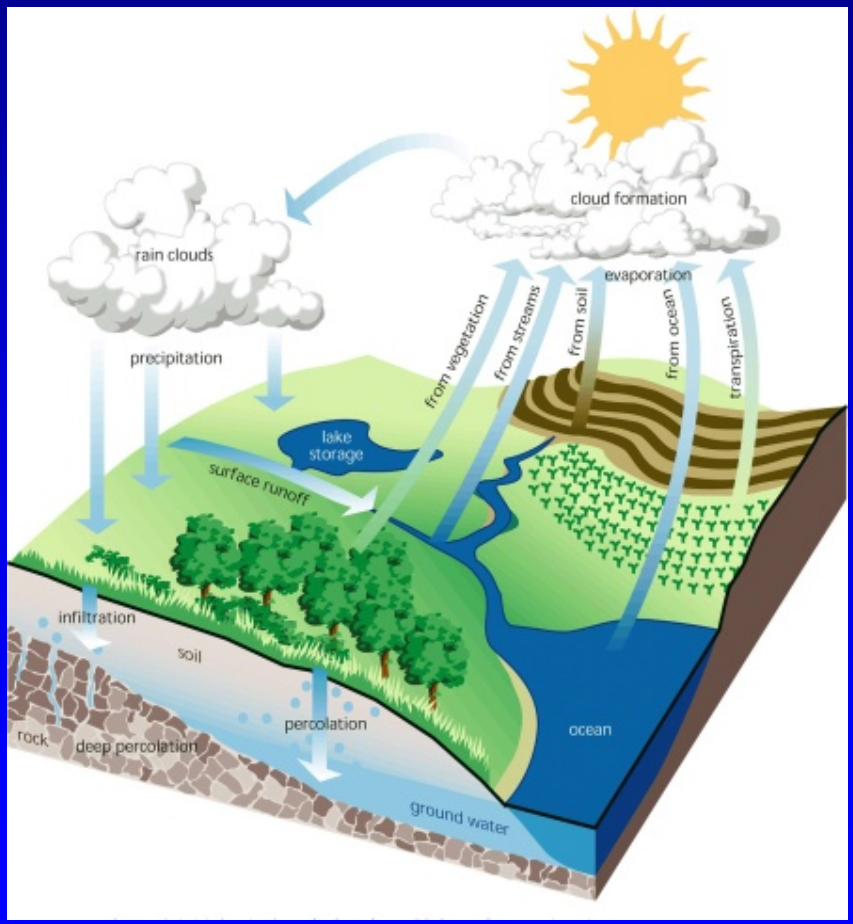
Randy Greer, PE
Delaware DNREC

Background

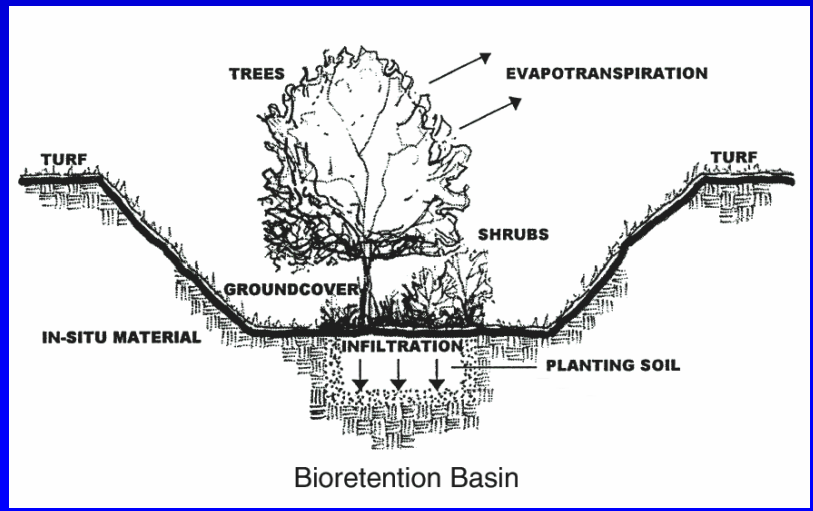


- Conservation Design Manual released in 1997
- Goals
  - Maximize recharge
  - Minimize runoff
  - Reduced reliance on structural SWM

“Non-Structural” SWM



- Hydrologic Cycle
- Bioretention: Mimic Natural Hydrologic Cycle



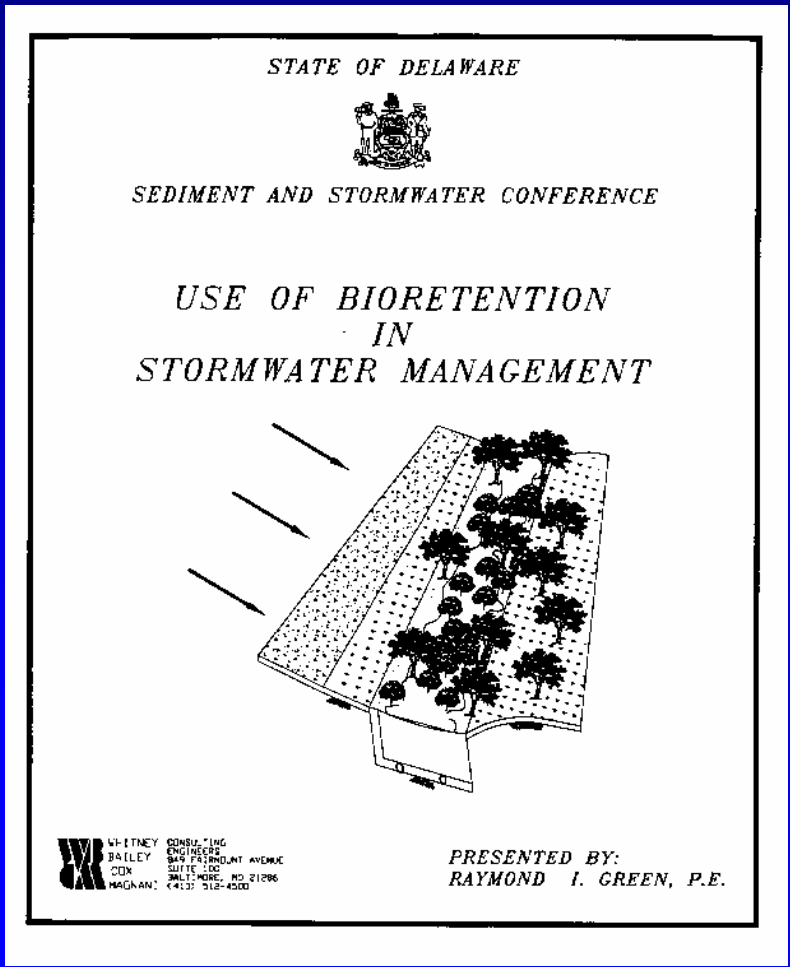
Bioretention Basin

Bioretention Pollutant Removal

		Cu	Pb	Zn	P	TKN	NH4	NO3
BOX	Upper	90	93	87	0	37	54	-97
	Middle	93	99	98	73	60	86	-194
	Lower	93	99	99	81	68	79	23
	Field	**97**	**96**	**95**	**65**	**52**	**92**	**16**

Dr. Allen Davis, University of Maryland
Derek Winogradoff, Senior Engineer, Prince George's County, Md.

Bioretention – “Past”


STATE OF DELAWARE

SEDIMENT AND STORMWATER CONFERENCE

USE OF BIORETENTION
IN
STORMWATER MANAGEMENT

WHITNEY BAILEY COX MAGNANI CONSULTING ENGINEERS 949 FAIRMOUNT AVENUE SUITE 100 BALTIMORE, MD 21286 (410) 512-4500

PRESENTED BY:
RAYMOND I. GREEN, P.E.

- Original guidelines from PG County, MD
  - Sizing criteria
  - Materials
  - Plant selection

Many Successful Installations!

Some Not-So-Successful Installations

- “Let it Rain”
- Day 1 – No Problem
- Day 4 – Problem?
- Day 10 – PROBLEM!

“Anecdotal Forensics”

- Approx. 25% failure rate – Unacceptable
- 4 Issues Identified
  - Design
  - Construction
  - Materials
  - Maintenance

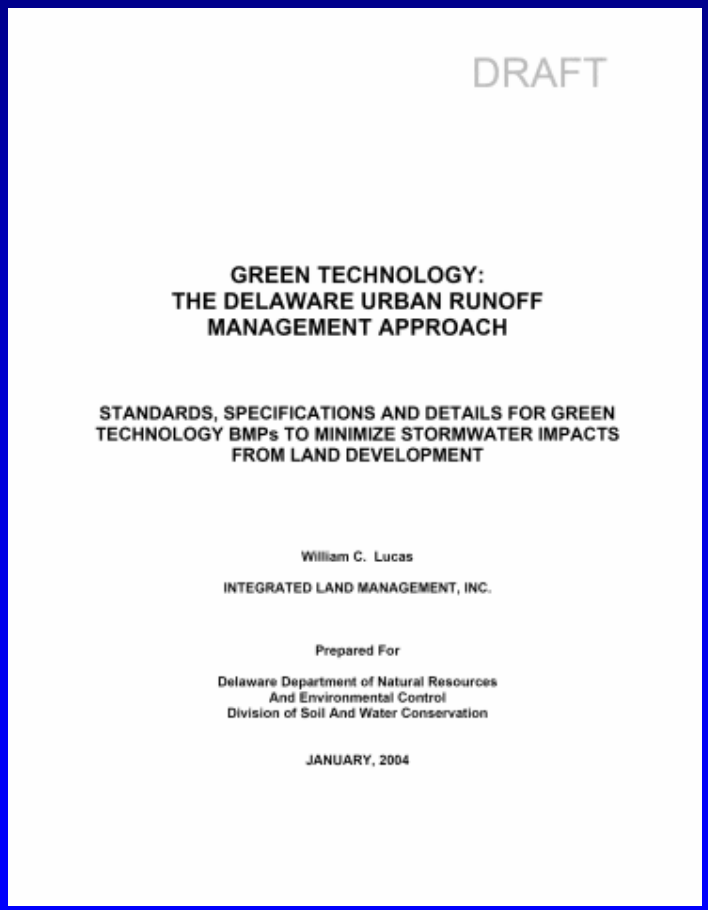
Design Issues

Construction Issues

Material Issues

Maintenance Issues

Bioretention – "Present"



DRAFT

GREEN TECHNOLOGY:
THE DELAWARE URBAN RUNOFF
MANAGEMENT APPROACH

STANDARDS, SPECIFICATIONS AND DETAILS FOR GREEN TECHNOLOGY BMPs TO MINIMIZE STORMWATER IMPACTS FROM LAND DEVELOPMENT

William C. Lucas

INTEGRATED LAND MANAGEMENT, INC.

Prepared For

Delaware Department of Natural Resources
And Environmental Control
Division of Soil And Water Conservation

JANUARY, 2004

- "Green Technology"
  - Bioswales
  - Filter strips
  - Terraces
  - Riparian Buffers
  - Bioretention

Standards & Specifications

DRAFT

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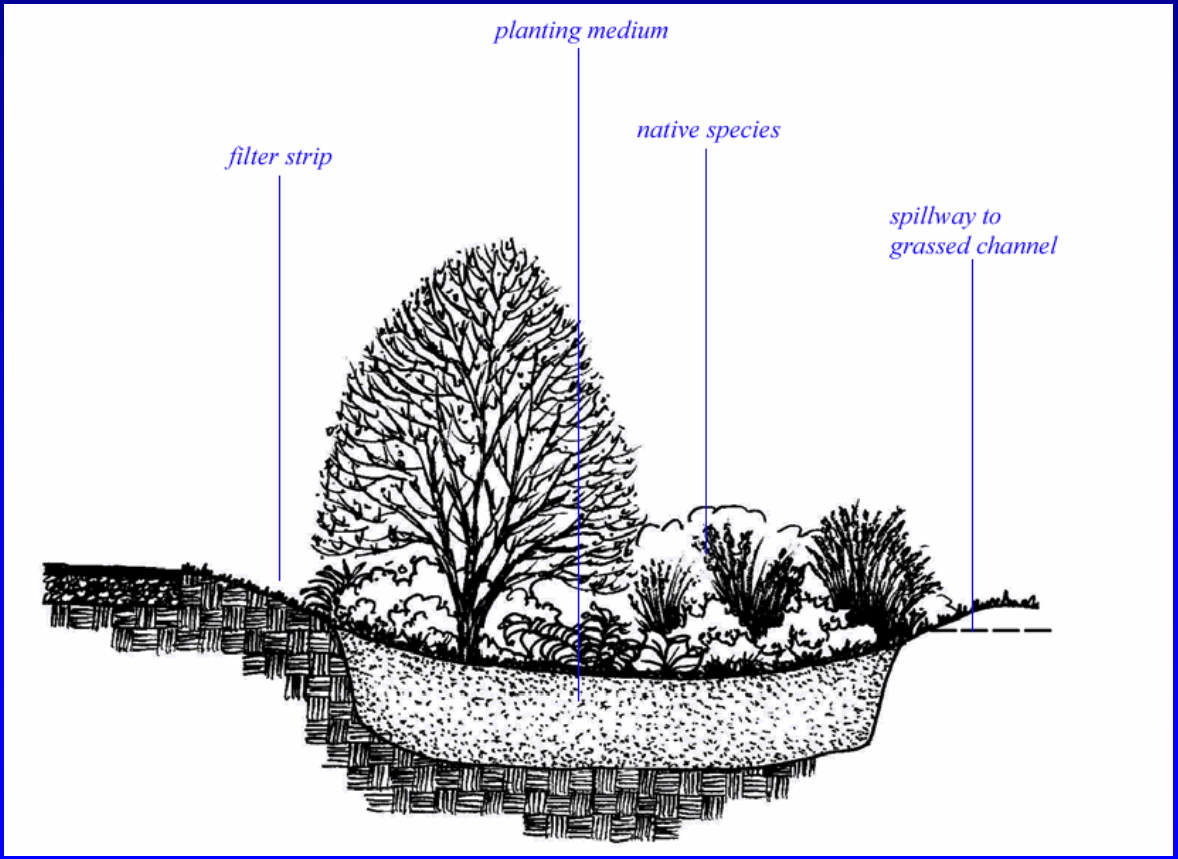
JANUARY, 2004

- Design guidelines
- Typical detail
- Material specifications
- Plant lists
- Construction methods
- Maintenance guidelines

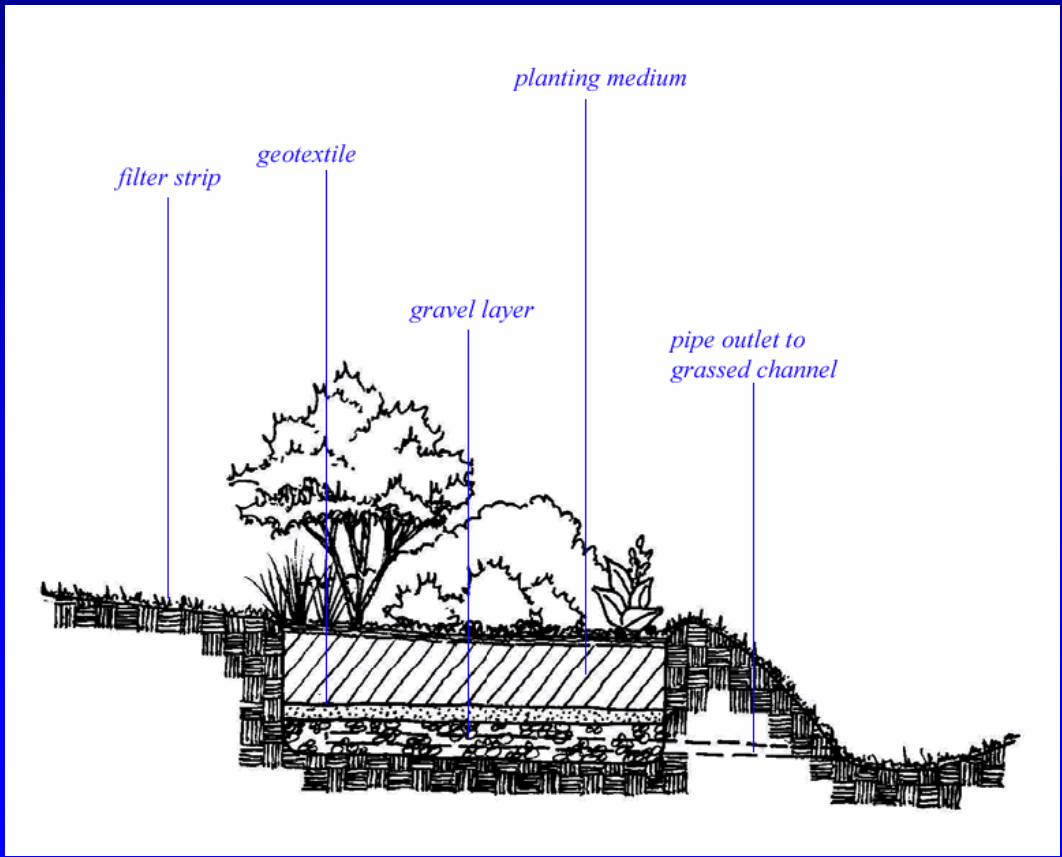
Conceptual Design: Infiltration

(Min. Infiltration Rate = 1.2 in/hr)

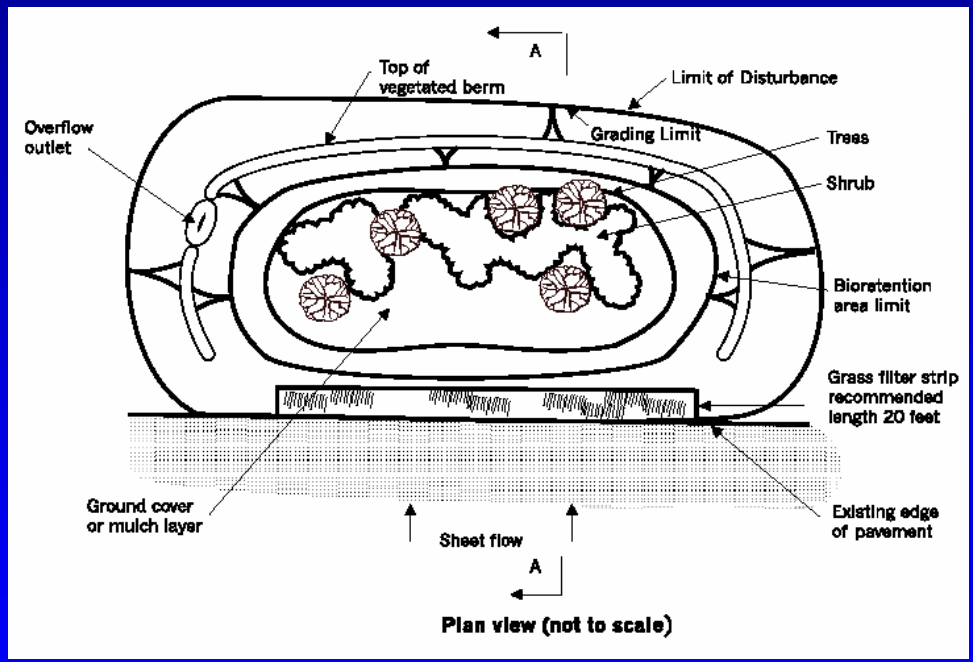


Conceptual Design: Underdrain

(Preferred)

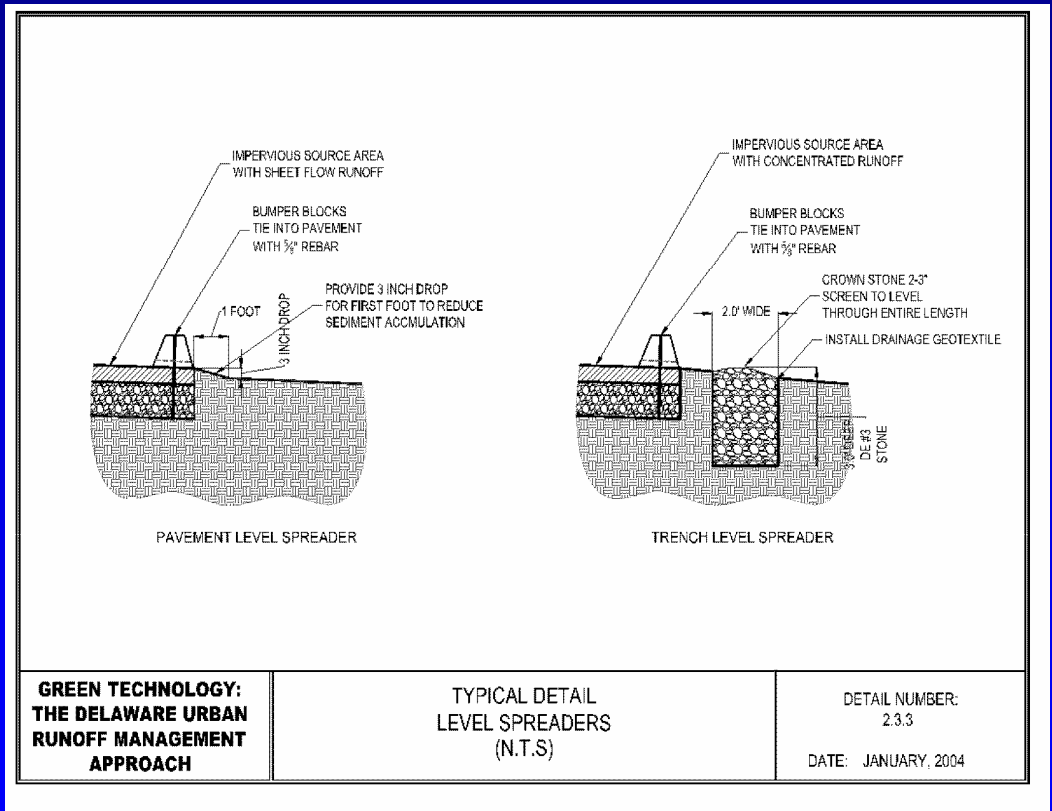


Conceptual Design: Plan View



- Trees outside biosoil media
- Planted areas ≤ 50%
- Spacing within planted areas based on species

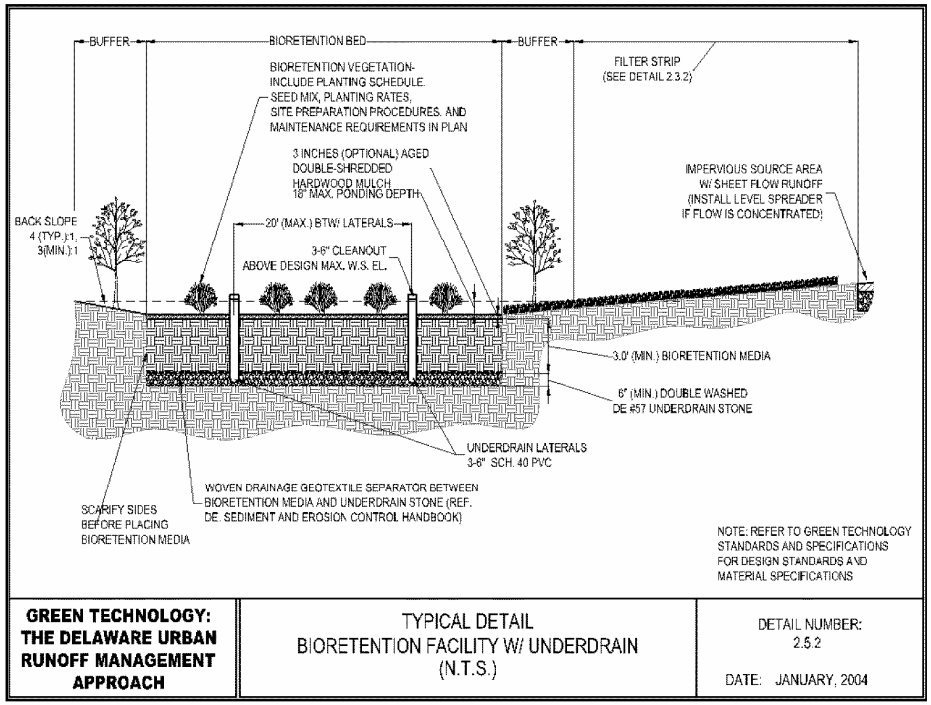
Bioretention - Typical Details



- Infiltration
- Underdrain
- Level spreader

Material Specifications

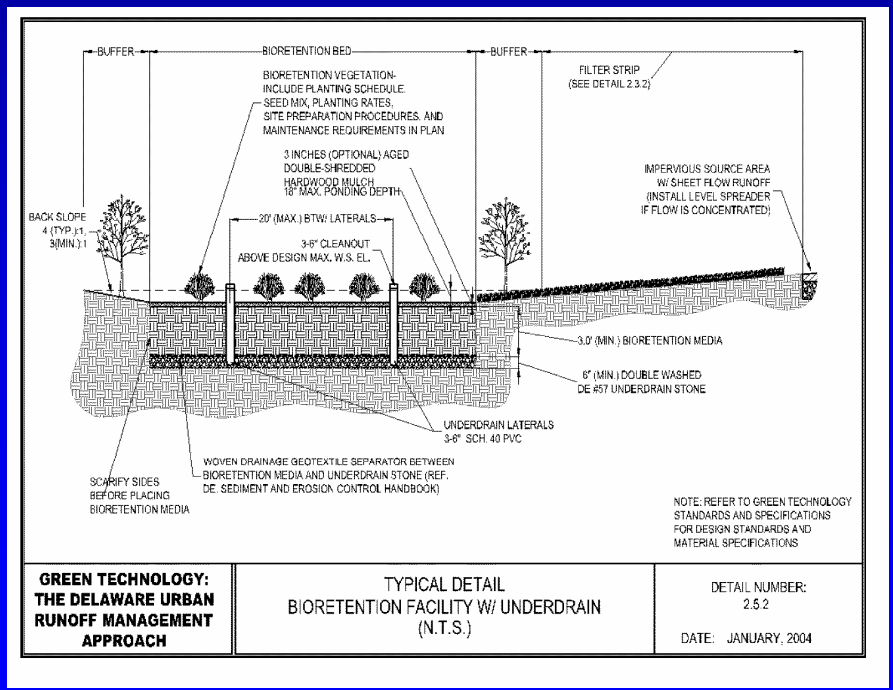
Typical Section



- 2”-3” mulch (optional)
- Min. 3’ planting soil
- Woven geotextile; ≥ 150 gpm
- Underdrain layer
  - 4”-6” pipe
  - 6”-8” DE #57 stone

Material Specifications

Planting Soil Mix



- Equal parts by volume
  - Triple-shredded hardwood mulch
  - Sphagnum peat
  - Concrete sand
- Drum mixed batch
- DNREC approved supplier

Recommended Plants List

DRAFT

TABLE 3-1: Grasses, Sedges, Rushes and Wetland Plants for Green Technology BMPs
(Photographs provided by permission from Ernst Seeds Inc.)

BOTANICAL NAME	COMMON NAME	WET TOLER.	FLOOD TOLER.	DROUGHT TOLER.	SHADE TOLER.	SUN TOLER.	HEIGHT	WILDLIFE VALUE	[illegible]
COOL SEASON GRASSES									
Agrostis alba	Red Top	♦♦♦♦	♦♦♦	♦♦	♦♦	♦♦♦	♦	♦♦	[P]
Elymus canadensis	Canada wild rye	♦♦	♦♦	♦♦	♦	♦♦♦	♦♦	♦♦	
Elymus hystrix	Bottlebrush Grass	♦♦	♦♦	♦	♦♦♦	♦	♦	♦	
Elymus riparius	Riverbank wild rye	♦♦♦	♦♦♦	♦♦	♦♦	♦♦	♦♦	♦♦	
Elymus villosus	Eastern Wild Rye	♦♦	♦♦♦	♦♦	♦♦	♦♦♦	♦♦	♦♦	
Elymus virginicus	Virginia Wild Rye	♦♦♦	♦♦♦	♦♦	♦♦♦	♦♦	♦♦	♦♦	(P)
WARM SEASON GRASSES									
Andropogon gerardi	Big Bluestem	♦	♦♦	♦♦♦	♦	♦♦♦	♦♦♦	♦♦♦	P
Andropogon virginicus	Broom Sedge	♦	♦♦♦	♦♦♦	♦♦	♦♦♦	♦♦	♦♦	P,V
Bouteloua curtipendula	Side Oats Grama	♦	♦♦	♦♦	♦	♦♦♦	♦	♦♦	P
Calamagrostis canadensis	Canada Bluejoint	♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦♦♦	♦♦	A
Chasmanthium latifolium	River Oats	♦♦	♦♦♦	♦♦	♦♦	♦♦♦	♦	♦♦	
Cinna arundinacea	Wood Reedgrass	♦♦♦	♦♦♦	♦	♦♦♦	♦♦	♦♦	♦♦	
Glyceria canadensis	Rattlesnake Grass	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦	♦♦♦	
Glyceria Striata	Manna Grass	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦♦	♦♦♦	
Panicum amarum	Coastal Panicgrass	♦♦♦	♦	♦♦♦	♦	♦♦♦	♦♦♦	♦♦	
Panicum virgatum	Switchgrass	♦♦♦	♦♦♦	♦♦♦	♦	♦♦♦	♦♦	♦♦♦	[P]
Schizachyrium Scoparium	Little Bluestem	♦	♦	♦♦♦	♦	♦♦♦	♦	♦♦♦	P
Sorghastrum nutans	Indiangrass	♦♦	♦♦	♦♦♦	♦	♦♦♦	♦♦♦	♦♦	P
Spartina pectinata	Prairie Cord Grass	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦♦♦	♦♦	(P)
Tridens flavus	Purpletop	♦♦♦	♦♦♦	♦♦♦	♦♦	♦♦	♦♦	♦♦	V
Tripsacum dactyloides	E. Gamagrass	♦♦♦	♦♦♦	♦	♦	♦♦♦	♦♦♦	♦♦♦	P
SEDGES									
Carex Annectens	Yellow Fruited Sedge	♦♦♦	♦♦♦	♦♦♦	♦	♦♦♦	♦♦	♦	
Carex communis	Colonial Sedge	♦♦	♦♦	♦♦	♦♦♦	♦♦♦	♦	♦	
Carex crinita var. crinita	Fringed sedge	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦♦	♦♦	
Carex emoryi	Emory's Sedge	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦	♦	
Carex gracillima	Graceful Sedge	♦♦	♦♦	♦♦	♦♦	♦♦	♦	♦♦	
Carex grayi	Gray's Sedge	♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦	♦	
Carex intumescens	Bladder Sedge	♦♦♦	♦♦	♦	♦♦	♦♦♦	♦♦	♦♦	
Carex lupulina	Hop Sedge	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦♦	♦♦	
Carex Lurida	Shallow Sedge/Lurid Sedge	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦♦	♦♦	
Carex pensylvanica	High meadow sedge	♦♦	♦♦	♦	♦♦♦	♦♦	♦	♦	
Carex scoparia	Blunt Broomsedge	♦♦♦	♦♦♦	♦♦	♦	♦♦♦	♦	♦♦	
Carex stipata	Awl/Stalk-grain Sedge	♦♦♦	♦♦♦	♦♦	♦	♦♦♦	♦	♦♦	
Carex stricta	Tussock Sedge	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦	♦♦♦	
Carex tribuloides	Bristlebract Sedge	♦♦♦	♦♦♦	♦	♦	♦♦♦	♦♦	♦♦	
Carex vulpinoidea	Fox Sedge	♦♦♦♦	♦♦♦	♦♦♦	♦♦	♦♦♦	♦♦	♦♦	
RUSHES AND WETLAND PLANTS									
Acorus Calamus	Sweet Flag	♦♦♦♦	♦♦♦	♦♦	♦	♦♦♦	♦♦	♦	
Caltha palustris	Marsh Marigold	♦♦♦♦	♦♦♦	-	♦	♦♦♦	♦♦	♦	
Iris Pseudacorus	Yellow Iris	♦♦♦♦	♦♦♦	-	♦	♦♦♦	♦♦	♦	
Iris versicolor	Blue Flag	♦♦♦♦	♦♦♦	-	♦♦	♦♦♦	♦	♦	
Eleocharis obtusa palustris	Blunt Spike Rush	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦	♦♦	
Juncus canadensis	Canadian Rush	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦♦	♦♦	
Juncus effusus	Soft Rush	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦♦♦	♦♦	
Juncus tenuis	Path Rush	♦♦	♦♦	♦♦	♦♦	♦♦♦	♦	♦	
Juncus torreyi	Torrey's Rush	♦♦♦	♦♦♦	♦♦	♦	♦♦♦	♦	♦♦	
Scirpus Cyperinus	Woolgrass	♦♦♦	♦♦♦	♦♦♦	♦	♦♦♦	♦♦♦	♦♦	
Scirpus Fluviatilis	River Bulrush	♦♦♦♦	♦♦♦	♦	♦♦	♦♦♦	♦♦♦	♦	
Scirpus pungens/americanus	Common 3 Square	♦♦♦♦	♦♦♦	♦♦♦	♦	♦♦♦	♦♦♦	♦♦♦	
Scirpus Tabernaemontani	Soft-Stem Bulrush	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦♦	♦	
Polygonum Pensylvanicum	PA Smartweed	♦♦♦♦	♦♦♦	♦	♦	♦♦♦	♦	♦♦	

Construction Methods

- Excavate from side
- Avoid compaction of biosoil media
- Stabilize all contributing areas

Future of Bioretention

- On-going research
- Certification of biosoil media
- Pilot studies of alternative designs


Questions?